

TRANSFERRING THE FLASHJET® COATING REMOVAL PROCESS TO DEPARTMENT OF DEFENSE FACILITIES

Dean W. Hutchins
U.S. Army Environmental Center
Pollution Prevention Acquisition Team
Aberdeen Proving Ground, MD 21010-5401
(410) 612-6855/6836
dwhutchi@aec.apgea.army.mil

Thomas L. Nied, Jr.
The Boeing Company
St. Louis, MO 63166-0516

ABSTRACT

For the past ten years there have been efforts by private industry and the Department of Defense (DOD) to find environmentally compliant methods for removing coatings off of substrates. This thrust has focused on finding depainting methods that minimize the use of hazardous substances. One environmentally compliant depainting method developed includes the combination of the xenon-flashlamp and carbon dioxide depainting technologies. This method is better known as the FLASHJET® coatings removal process.

The FLASHJET® coatings removal process has great potential for depainting activities within the DOD. The U.S. Navy has recently approved the use of the FLASHJET® coatings removal process on metallic fixed wing aircraft and there are many more applications within the three services where the FLASHJET® process can be utilized. For this reason the U.S. Army Environmental Center has partnered with experts on depainting processes from the U.S. Army, U.S. Navy, U.S. Air Force, the National Defense Center for Environmental Excellence (NDCEE), and The Boeing Company (formerly the McDonnell Douglas Corp.) to look at incorporating the FLASHJET® coatings removal process into DOD processes which currently use other harmful depainting methods. This project team has received funding support from the Environmental Security Technology Certification Program (ESTCP).

This 18-month ESTCP demonstration/validation will be conducted in two segments. The FLASHJET® coatings removal process will be evaluated on rotary wing aircraft during the first year of the demonstration. Ground vehicles including one Bradley Fighting Vehicle are scheduled to be evaluated in the second year of the demonstration.

BACKGROUND

In 1987 a study performed at the U.S. Air Force Sacramento Air Logistics Center evaluated xenon-flashlamps for removing aircraft coatings. The results of the evaluation concluded that although the xenon-flashlamp could remove aircraft coatings from metallic and composite substrates to the primer, high temperatures were recorded on the substrate and the effluent ash

was not being contained. The xenon-flashlamp technology proved to be effective; however there were still some issues that needed to be addressed. In 1990 the Warner-Robins Air Logistics Center looked into using carbon dioxide pellet blasting to remove paint from metallic structures. The process was proven effective, but there were concerns regarding the stripping of composite and thin metallic substrates. In 1990 a team of engineers from the McDonnell Douglas Corp., Cold Jet Inc., and Maxwell Laboratories Inc. combined the xenon-flashlamp and carbon dioxide pellet blasting technologies into one process, and this became what is called the FLASHJET® coatings removal process.

THE FLASHJET® PROCESS

The FLASHJET® process combines a xenon-flashlamp with low pressure carbon dioxide (dry ice) pellet blasting. The xenon-flashlamp is the primary coating removal mechanism. Pulsed-light energy generated from the xenon-flashlamp ablates the coating, reducing it to a fine ash. The xenon gas absorbs the electrical energy and releases photons that are emitted from the flashlamp head, which pulses 4 to 6 times per second. A continuous stream of dry ice pellets are also used in the process. Dry ice pellets cool and clean the flashlamp and the underlying substrate, which can reach temperatures as high as 230°F. The dry ice pellets also sweep away the effluent ash, which is vacuumed into an effluent capture system. This effluent capture system contains a series of High Efficiency Particulate Air (HEPA) filters that capture the effluent ash. These spent HEPA filters are the only waste created in the FLASHJET® process. All HEPA filters are tested for toxicity characteristics and then sent to designated landfills. The carbon dioxide used in the FLASHJET® process is captured from industrial sources and re-used to produce the dry ice pellets, thus no net addition of carbon dioxide is emitted into the atmosphere during the stripping process. Organic vapors generated during the ablation of the coating are vacuumed into the effluent capture system and processed through an activated charcoal tank.

The FLASHJET® process is a fully automated process with limited operator involvement. Once a new piece of equipment is rolled into the stripping area, operators program scan paths which the robotic FLASHJET® stripping head follows during the stripping process. Scan paths are saved on a central computer and used when the next similar application is ready to be stripped, thus no additional programming is required. As required by the Occupational Safety and Health Administration, 2 operators need to be present at all times during the operation of robotic controls; therefore this rule applies to the FLASHJET® process. These operators are shielded in a designated control room from the harmfully bright ultraviolet light, the loud noise generated during the ablation process, and carbon dioxide levels inside the stripping bay.

Figure 1 is a picture of the FLASHJET® process removing the topcoat from an AH-64A Apache fuselage at The Boeing Company's FLASHJET® Paint Stripping Facility in Mesa, AZ.



Figure 1: AH-64 Apache Helicopter being stripped using the FLASHJET® process

TECHNICAL MATURITY

In 1991 the Warner-Robins Air Logistics Center (WR-ALC) contracted with the McDonnell Douglas Corp. to produce a “proof-of-concept” 6-inch lamp prototype for stripping F-15 composite type parts. This 6-inch lamp was proven successful in stripping F-15 Boron/Epoxy vertical stabilizers. This was the first proof that the FLASHJET® coatings removal process would be able to strip composite type materials without damage to the substrate. With the success of the 6-inch prototype FLASHJET® system, the U.S. Navy began to take an interest in the FLASHJET® process. A follow-on study was initiated by the Naval Aviation Depot – Jacksonville (NADEP-JAX) to look at metallic and other composite materials testing.

The results of the initial testing proved that the FLASHJET® coatings removal process is a viable technology for stripping composite and thin metallic substrates without any damage to the substrate. In 1994 WR-ALC and NADEP-JAX teamed up and submitted a Strategic Environmental Research and Development Program (SERDP) project titled “Aircraft Depainting Technologies.” This SERDP project looked to further validate the FLASHJET® coatings removal technology by performing further testing on aircraft substrates. Results from this testing led to Naval Air Systems Command approval for use of the FLASHJET® process on metallic fixed wing aircraft. Another objective of this SERDP project was to develop a mobile manipulator where the FLASHJET® stripping head could be attached to a robotic arm for stripping equipment, including fully assembled aircraft, without total disassembly. The operator

of the mobile manipulator could simply drive up to the piece of equipment and strip the equipment through the use of robotic controls. This mobile manipulator will be tested at NADEP-JAX on P-3 cargo aircraft in 1998.

The FLASHJET® coatings removal process has been extensively tested on other types of substrates and composites during its short history at The Boeing Company FLASHJET® Demonstration Paint Stripping Cell in St. Louis, MO and at the NDCEE in Johnstown, PA. Since 1996 The Boeing Company has been using the FLASHJET® process to strip AH-64A Apache fuselages at their AH-64A Apache FLASHJET® Paint Stripping Facility in Mesa, AZ. To date over 40 AH-64A fuselages have been stripped using the FLASHJET® process at the Mesa, AZ plant, at an approximate life cycle cost of \$3.75/ft².

DEMONSTRATION PLAN

This demonstration will look to validate the FLASHJET® coatings removal process on certain rotary wing and ground vehicle applications. Rotary wing applications to be demonstrated include the SH-60 and CH-53 off-aircraft components. Along with testing the equipment listed above, the U.S. Navy and U.S. Air Force project representatives will be conducting a High Cycle Fatigue Testing program to qualify the use of the FLASHJET® coatings removal process on 2024 T3 and 7075 T6 Aluminum rotary wing aircraft substrates. Results of this testing program will determine if the FLASHJET® process causes damage to these rotary wing aircraft substrates. Rotary wing application testing will be conducted in FY98. Ground vehicle application testing is planned for FY99. Ground vehicles to be evaluated include the Bradley Fighting Vehicle, the High Mobility Multipurpose Wheeled Vehicle, and a Command and Communications Shelter. All equipment evaluated in this demonstration will come under review of the Program Managers (PMs) of the tested equipment via a Joint Test Protocol (JTP), similar to the JTP format developed by the Joint Group for Acquisition Pollution Prevention. The JTP documents the testing that will be conducted on the PM's equipment and the criteria that will be used for determine the viability of the FLASHJET® process on their equipment. If all requirements are found within the JTP that are needed to qualify the FLASHJET® process on the weapon system, then the Program Manager gives an endorsement for the demonstration and will consider the technology if the results of the evaluation are acceptable.

The FLASHJET® demonstration will be conducted at The Boeing Company's AH-64A Apache FLASHJET® Paint Stripping Facility in Mesa, AZ. Once Program Managers of tested equipment endorse the JTP, the evaluation will begin in the summer of 1998.

COST SAVINGS

During the equipment evaluation, certain cost variables will be recorded, and an estimated life cycle cost per square foot will be calculated. The Environmental Cost Analysis Methodology (ECAM) model prepared by the NDCEE will be used as the primary life cycle cost estimating model for this demonstration. Along with the ECAM model, the U.S. Air Force Depaint Cost Comparison Model developed by Randy Ivey from WR-ALC will be used as another model for estimating life cycle costs. This WR-ALC cost model has been extensively evaluated on aircraft

at several Air Force and Navy installations. The model is also being used to estimate life cycle costs for ground vehicle applications at Army and Marine Corps installations.

Recently the WR-ALC model was used to determine an estimated life cycle cost per square foot for the U.S. Army National Guard's 1108th AVCRAD at Gulfport, MS. Currently the 1108th AVCRAD uses plastic media blasting to depaint rotary wing aircraft, including the UH-60, AH-64, UH-1, AH-1, and OH-53, and the 1108th AVCRAD personnel wanted an estimated life cycle cost per square foot for using the FLASHJET® process versus plastic media blasting. Table 1 gives an estimated life cycle cost per square foot for FLASHJET® versus plastic media blasting. The life cycle cost figures for the FLASHJET® process are significantly lower due to the limited worker involvement and minimal waste disposal.

Table 1: Estimated Life Cycle Costs Per Square Foot for the 1108th AVCRAD, MS

Aircraft	Plastic Media Blasting	FLASHJET®
UH-60	\$21.94	\$3.62
AH-64	\$22.45	\$3.83
UH-1	\$20.04	\$4.03
AH-1	\$25.47	\$4.17
OH-58	\$34.04	\$3.62

CONCLUSIONS

At the conclusion of this 18-month demonstration, the FLASHJET® coatings removal process will be proven as a viable technology for most rotary wing and ground vehicle applications. Results of the High Cycle Fatigue Test will show that the FLASHJET® process is a safe alternative for coatings removal for certain rotary wing aircraft substrates. Estimated life cycle costs calculated in the demonstration will show that the FLASHJET® process will save DOD depainting installations money over other commonly used depainting methods that have higher life cycle costs.

ACKNOWLEDGEMENTS

This study is currently being funded through the Department of Defense Environmental Security Technology Certification Program administered through the U.S. Army Environmental Center at Aberdeen Proving Ground, MD. The program manager of this project is Dean Hutchins of the U.S. Army Environmental Center. Other project team members include Tony Pollard from Anniston Army Depot, AL; Alex Kachura from Fort Hood, TX; LTC James Moye from the Arizona Army National Guard; Steven Hartle from Patuxent River Naval Air Station, MD; Mark Meno from Naval Aviation Depot at Cherry Point, NC; Randy Ivey from Warner-Robins Air Logistics Center, GA; Fred Lancaster and Deanna Hart from the National Defense Center for Environmental Excellence in Johnstown, PA; and Wayne Schmitz, David Briehan, and Tom Nied from The Boeing Company in St. Louis, MO.